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PART IV

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

Office of Assistant Secretary for Housing—Federal Housing Commissioner

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SOLAR HEATING AND DOMESTIC HOT WATER SYSTEMS

Intermediate Supplement to Minimum Property Standards

Title 24—Housing and Urban Development

CHAPTER II—OFFICE OF THE ASSISTANT SECRETARY FOR HOUSING—FEDERAL HOUSING COMMISSIONER, DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

[Docket No. R-77-459]

PART 200—INTERMEDIATE MINIMUM PROPERTY STANDARDS FOR SOLAR HEATING AND DOMESTIC HOT WATER SYSTEMS

Intermediate Supplement to HUD's Minimum Property Standards; Publication and Availability

AGENCY: Office of the Assistant Secretary for Housing—Federal Housing Commissioner, Department of Housing and Urban Development.

ACTION: Final rulemaking.

SUMMARY: This rule adopts the Intermediate Minimum Property Standards for Solar Heating and Domestic Hot Water Systems (S/MPS). The basic MPS define the minimum level of quality acceptable for single family residences, multifamily residences, nursing homes, and intermediate care facilities designed and constructed under HUD programs. The S/MPS is needed to provide a companion technical basis for the planning and design of solar heating and domestic hot water systems.

EFFECTIVE DATE: July 30, 1977.

FOR FURTHER INFORMATION CONTACT:

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SUPPLEMENTARY INFORMATION: On July 12, 1976, HUD published a notice (41 FR 28570) of its intention to develop new supplementary intermediate minimum property standards for solar heating and domestic hot water systems (S/MPS). The primary purpose of the proposed standards is to describe the aspects of solar planning and design that differ from conventional systems. The S/MPS are based on current state-of-the-art practice and on nationally recognized standards. The S/MPS, 4930.2, is intended as a temporary, (to be superseded at a later date) supplement to the Minimum Property Standards (MPS) for One-and-Two-Family Dwellings, 4900.1, the Minimum Property Standards for Multifamily Housing, 4910.1, and the Minimum Property Standards for Care-Type Housing, 4920.1

The S/MPS are incorporated by reference into 24 CFR 200.929 of the Code of Federal Regulations. Accordingly, 24 CFR 200.929(b) is amended to read as follows:

(b) *Identification.* The Minimum Property Standards have been published in four volumes:

(1) MPS for One- and Two Family Dwellings 4900.1

(2) MPS for Multifamily Dwellings 4910.1

(3) MPS for Care-Type Housing 4920.1

(4) Intermediate Minimum Property Standards for Solar Heating and Domestic Hot Water Systems (S/MPS) 4930.2. This volume applies to buildings containing one or more living units, nursing homes, and intermediate care facilities.

In general, the chapters and divisions of the S/MPS parallel the chapters and divisions of the MPS. Within divisions, however, the S/MPS list solar topics sequentially and do not follow the MPS numbering. This permits introduction of new topics in a manner clearly related to the MPS while avoiding a cumbersome effect.

Fifty comments were received in response to the notice published in July 12, 1976. A number of commenters raised questions or made suggestions which led to changes from the proposed standards. Additionally, in order to improve the organization of the S/MPS a number of sections, tables and figures have been relocated and redesignated within the document and others deleted or added. They are identified in tables for easy reference.

The discussion of comments will be referenced to the old section number and the number applicable currently to the subject matter will be shown in parentheses.

Redesignated sections

Old section	*New section*
S-311-5	S-311-7.1
S-311-7.1	S-311-7.2
S-401-1.1	S-615-1.6.2
S-401-1.2	S-615-1.6.3
S-405-1.1	S-405-4.1
S-405-4	S-405-4.2
S-515-1	S-515-1, S-515-1.1
S-515-1.1	S-515-1.2
S-515-1.2	S-515-1.3
S-515-1.3	S-515-1.4
S-515-1.4	S-515-1.5
S-515-1.5	S-515-1.6
S-515-1.6	S-515-1.7
S-515-1.7	S-515-1.8
S-515-1.8	S-515-1.9
S-515-2.1.3	S-515-2.1.4
S-515-2.1.4	S-615-2.1.10
S-515-2.2.4	S-515-2.2.1.1
S-515-2.2.5	S-515-2.2.1.2
S-515-2.2.6	S-515-2.2.3.1
S-515-2.2.7	S-515-2.2.3.2
S-515-2.2.8	S-615-2.1.4
S-515-2.2.9	S-515-2.1.3
S-515-2.2.10	S-615-2.1.9
S-515-2.2.11	S-405-12
S-515-2.2.12	S-515-2.2.3.3
S-515-2.2.13	S-515-2.2.3.4
S-515-2.3.1	S-515-2.3.2.1
S-515-2.3.2	S-515-2.3.2.2
S-515-2.3.3.	S-515-2.3.2.3
S-515-2.3.4	S-515-2.3.2.4
S-515-2.4.2	S-515-2.4.2.1
S-515-2.4.3	S-515-2.4.2.2
S-515-2.4.4	S-515-2.4.2.3
S-515-2.4.5	S-515-2.4.2.4
S-515-2.5.1	S-515-2.5.2.1
S-515-2.5.2	None
S-515-2.5.3	S-515-2.5.1
S-515-2.5.4	S-515-2.5.1
S-515-2.6.2	S-515-2.6.2.1
S-515-2.6.3	S-515-2.6.2.2
S-515-2.6.4	None
S-515-3.1.3	S-515-3.2.1
S-515-3.1.4	S-515-3.2.2
S-515-3.1.5	S-515-3.2.3
S-515-3.1.6	S-515-3.2.4
S-515-3.1.7	S-515-3.2.5
S-515-3.2	S-515-3.3
S-515-3.2.1	S-515-3.3.1
S-515-3.2.2	None
S-515-3.2.3	None
S-515-3.2.4	S-515-3.3.2
S-515-3.2.5	S-515-3.3.3
S-515-4.2	S-515-4.1
S-515-4.3	S-515-4.1
S-515-4.4	S-515-4.2
S-515-4.5	S-515-4.2
S-515-4.6	S-515-4.2
S-515-4.7	S-515-4.2
S-515-4.8	S-515-4.3
S-515-6.2	S-515-6.1
S-515-7.3	S-515-7.4.1
S-515-7.4	S-515-7.4.2
S-515-8.1.2	S-515-8.1
S-515-8.2.4	S-615-9
S-515-8.3	S-515-8.3.1
S-515-8.4	S-515-8.3.2
S-515-8.5	S-515-8.3.3
S-515-9.1	S-515-9.2
S-515-9.2	S-515-9.2.1
S-515-9.3	S-515-9.2.2
S-515-11.2	S-515-11.2.1
S-515-11.2.1	S-515-11.2.1.1
S-515-11.2.2	S-515-11.2.1.1
S-515-11.3	S-515-11.2.2
S-515-11.4	S-515-11.2.3
S-515-11.5	S-515-11.1
S-515-11.6	S-515-11.1
S-515-12.2	S-515-12.2.1
S-515-12.3	S-515-12.2.2
S-515-13.1	None
S-515-13.2	S-515-13.1.1
S-515-13.2.1	S-515-13.1.1
S-515-13.2.2	S-515-13.1.2
S-515-13.2.3	S-515-13.1.3
S-515-13.2.4	S-515-13.1.4
S-515-13.2.5	S-515-13.1.5
S-600-5	S-600-5.1
S-600-6.2	S-405-4.2
S-601-5.2.1	S-601-5.2
S-601-5.2.2	S-601-5.3
S-601-6.2.1	S-601-6.2
S-601-6.2.2	None
S-601-8	S-601-3.2
S-601-13	S-601-8
S-607-3.1	S-607-3.2
S-607-3.2	S-607-3.1
S-615-2.1.4	S-615-2.1.6
S-615-2.1.5	S-615-2.1.7
S-615-2.1.6	S-615-2.1.8
S-615-2.2.1a	S-615-2.2.2
S-615-2.2.1b	S-615-2.2.3
S-615-2.2.1c	S-615-2.2.4
S-615-7.1	S-615-7.3
S-615-7.1.1	S-615-7.1
S-615-7.1.2	S-615-7.3.1
S-615-7.1.3	S-615-7.3.2
S-615-7.1.4	S-615-7.3.3
S-615-7.1.5	S-615-7.3.4
S-615-7.1.6	S-615-7.4
S-615-7.1.7	S-615-1.4.1.2
S-615-7.1.8	S-615-7.5
S-615-10.3	S-615-10.5
S-615-10.4	S-615-10.6
S-615-10.5	S-615-10.7
S-615-10.5.1	S-615-10.7.1
S-615-10.5.2	S-615-10.7.2
S-615-10.5.3	S-615-10.7.3
S-615-10.5.4	S-615-10.8
S-615-10.6	S-615-10.9
S-615-10.7	S-615-10.10
	S-615-10.10.1
S-615-10.8	S-615-10.11
S-615-10.9	S-615-10.12
S-615-10.10	S-615-10.13
S-615-10.11	S-615-10.14
S-615-10.12	None
S-615-11.1 a and b	S-615-11.1.1
S-615-11.1c	S-615-11.1.2
S-615-12.2	S-615-10.1
S-615-14.2.1	S-615-14.1.1
S-615-14.2.2	S-615-14.1.1
S-615-14.3	S-615-14.2
S-615-14.4	S-615-14.3
S-615-14.5	S-615-14.4

Redesignated figures/tables

Old	New
Figure S-601.1a	None.
Figure S-601.1b	None.
Figure S-601.1c	None.
Figure S-601.1d	None.
Figure S-601.2	Figure S-601-7.
Table S-601.2	Table S-601-6.
Table 601.3	Table S-601-7.

New sections/tables added

Old	New
S-102	S-607.2.1
S-405-1.1	S-615-1
1-405-12	Table S-615.1
S-501-4	S-615-1.9
S-515-1	S-615-2.1.11
S-515-1.10	S-615-2.2.5
S-515-2.13	S-615-7.2
S-515-2.2.3	S-615-7.6
S-515-2.2.3.1	S-615-7.7
S-515-2.3.3.2	S-615-7.8
S-515-2.3.1	S-615-7.9
S-515-2.3.2	S-615-8.1.3
S-515-5.2	S-615-10.3
S-515-6.2	S-615-10.4
S-515-7.3	S-615-10.10.2
S-515-9.1	S-615-10.15
S-515-9.3	S-615-10.15.1
S-515-12.2	S-615-10.15.2
S-600-5.2	S-615-11.2
S-607-2	S-615-12.2

DISCUSSION OF MAJOR COMMENTS

All comments were read, reviewed, and considered. In a number of instances, the comments were of a minor or editorial nature and were of assistance in the preparation of the reviewed document but are not reviewed in this discussion. Some of the comments were of general commendation and others were of general criticism. Being non specific, these are not discussed further. A number of comments related experiences of the respondent with solar energy and made no specific recommended changes. In a number of instances, comments were made which would have been answered had the respondent read the S/MPS document in conjunction with the MPS as is the intended use as pointed out in S-100 of the S/MPS. The current document has been made applicable to the MPS for Care-Type Housing 4920.1. The only substantive change caused by this inclusion of care-type housing is reflected in the requirements for domestic hot water temperatures in § 615-1.4.2.

GENERAL COMMENTS

Three commenters felt the issuance of the document might be premature because of the infant state of the industry. It was felt that the size and state of development evidenced by the demonstration program and current private installations and the need for guide criteria for Federal programs indicated that preliminary standards were needed. This suggestion was not recognized; however, provisions were included at the beginning of the document in Chapter 1 to allow variations to the standards for new and innovative technologies.

A number of comments were received which related to the derivation of the document from and close relationship to the HUD Minimum Property Standards, 4900.1, and 4910.1. Included in this category were comments on the way standards were referenced, the complexity of the document, and the treatment of architectural concerns. It was felt that by structuring the document similar to the HUD MPS, a basis for industry familiarity was established.

Several comments were made on the organization of the document and the use of the commentary following the statement of the criteria. One commenter felt these were most helpful, and another feared that they might be used to set a standard. It was felt that due to the newness of the topics to many of those who must use the document that explanatory notes clearly set off in italics and with their advisory nature explained in the preface would be helpful.

A number of comments were concerned with the flexibility and adaptability of the standard, how it would be changed as the state-of-the-art changed and how judgmental issues raised by the standard would be handled. These are valid concerns but they were felt to be covered by the existing mechanisms employed by HUD in administering the MPS. Periodic revisions are a part of this administration as is a process for review and acceptance of new and innovative technologies. To aid in this understanding, reference to the review process was included in Chapter 1.

A comment was made that the standard was not well suited to multi-family installations because of their greater complexity. It was felt that though the total complexity is greater, the principles of design and elements of construction are covered by using several basic elements and thus the standard was applicable. Also, a number of the paragraphs are considerations that are applicable to multi-family installations exclusively and these have been set off in a special typeface.

Comments were made by several commenters on sections throughout the document with regard to their applicability to passive solar energy systems. The state of understanding of passive systems, in a quantitative sense, is not well advanced and thus it was difficult to develop meaningful criteria in a number of areas. An effort was made wherever possible to provide the latitude that would allow the consideration of passive systems. Of particular note in this regard are the sections on Thermal and Moisture Protection (S-607) and Thermal Design (S-615-1). It was also felt that the provisions of S-101, Variations to Standards, and S-501-4, Documentation of Performance, would be helpful in the case of passive systems.

One commenter suggested the desirability of using system and/or subsystem performance measures rather than tests on materials and components as a means for judging the suitability of a design. This was recognized as a desirable goal for a performance based standard and in fact many of the sections in Chapter 5 (Materials) are keyed to the 30-day collector thermal stability test (S-515-2.1.2) which is of the nature suggested. In other areas, tests are under development and should be incorporated in future revisions of the document.

CHAPTER 3—SITE DESIGN

S-303—LAND USE

A number of comments were received concerning the wording used and the fact that many of the criteria were judgmental. This section closely parallels the MPS in form and text and was felt to be appropriate since these land use criteria are meaningful in solar installations as well as conventional. Minor changes were made to improve clarity of meaning.

CHAPTER 4—BUILDING DESIGN

S-401—PASSIVE SOLAR SYSTEMS

A number of comments were received concerning the recommended surface temperature limits. Most commenters suggested raising the temperature limits. These limits are placed on surfaces in the living spaces of the building and do not govern conditions in other locations. It was felt that the temperatures given and the latitude allowed in other areas is sufficient for both active and passive installations. This section was moved to section S-615-1.6.2 and 615-1.6.3 where it relates directly to the preceding section on design air temperatures for passive systems.

S-405-7—FIRESTOPPING

Several commenters questioned the need for firestopping of all collectors. The intent of the section is that solar system components shall not decrease the effectiveness of firestopping that is currently required by the MPS. The paragraph was revised to clarify the intent.

CHAPTER 5—MATERIALS

S-500—GENERAL

Comments were received suggesting that: (1) adhesives be included along with other materials in Chapter 5, (2) the standards in Appendix E only be mentioned in the specific sections of the chapter to which they are applicable, and (3) criteria for alternative materials be specifically set forth. In addition, some commenters had the impression that all components and materials would have to undergo extensive laboratory testing to meet the intent of this chapter. Although adhesives are not mentioned specifically in Chapter 5, the general criteria in S-515-1.1 through S-515-1.10 apply to all materials, including adhesives, if they are used in the system. Subsection S-500-1 mentions Appendix E standards to conform to the established MPS format and to inform the reader that the standards mentioned in the chapter are compiled in one location. Criteria for alternative or special materials are set forth in the general provisions of S-500-3. It was felt that the document, as written, covers the comments received with the exception of those concerned about extensive testing. To satisfy these commenters, a new section, S-501-4, Documentation of Performance, has been added.

S-501—GENERAL REQUIREMENTS

S-501-1—GENERAL

Objection was made to the use of the term "acceptable durability." The commenter suggested that an acceptable design life be stated for each component or material and that solar equipment be required to have lifetimes of 20 years or more. However, the purpose of the S/MPS is to help ensure that materials will perform their intended functions for a period of time that is at least as long as that intended by the manufacturer or designer. Therefore, to specify a minimum design life for all materials would ignore the possible cost effectiveness of replacing or repairing components or materials. Accordingly, no change was made.

S-501-2—LABELING

Numerous comments were received regarding the extensive labeling required of components and materials. In general, the readers felt that less labeling should be required. It was agreed that less labeling was desirable and thus all labeling requirements were reviewed and revised to minimize the extent of labeling. Reference to the "Federal Hazardous Substance Labeling Act," Pub. L. 86-613, was deleted from this section and is now referenced in S-515-8.1.1 and S-615-8.1.2.

S-508—DOORS, WINDOWS, GLAZING PANELS

One commenter stated that some control screens are not louvered. Another commenter suggested deleting the section. The first comment appears valid but the section should not be deleted since solar control screening must provide this performance if it is to control insect entry as well. Therefore, the section was retained and the word "louvered" was deleted.

S-515—MECHANICAL SOLAR-POWERED EQUIPMENT

Commenters suggested that the terms "significantly impair" and "intended design life" be more clearly defined. Also, it was suggested that the criteria listed under 515-1 be made more specific. It was agreed that the above terms should be more clearly defined. The criteria (S-515-1.1 through S-515-1.10) were intended to identify general requirements to be met, as applicable, by all materials and components. These criteria are needed to state requirements for materials not specifically covered in the chapter. Therefore, the terms "significantly impair" and "intended design life" are more fully described in Appendix D under "significant (deterioration, loss, etc.)" and "design life." New sections were added to cover fire safety and leakage, S-515-1.1 and S-515-1.10.

S-515-1.3—TEMPERATURE AND PRESSURE RESISTANCE

Commenters felt that the use of no-flow conditions ruled out the use of many commonly used heat transfer fluids and that no-flow conditions may not be experienced if the system is designed to prevent stagnation. The requirement does not preclude the addition of new heat transfer fluid if it is degraded and hence, many fluids will not be ruled out for this reason. However, in general, materials exposed to stagnation conditions should be stable at those temperatures. No-flow testing of collectors with heat dump provisions is generally performed with those provisions included. The section was revised to provide more latitude in responding to these conditions.

S515-1.4—MATERIALS COMPATIBILITY

Comments were that: (1) Provisions should be made to allow for bimetallic connections which are properly protected, and (2) the wording should include effect of temperature fluctuations. The criterion does not preclude the use of properly joined bimetallic connections. However, the second comment appears valid. The wording of the criterion was changed to reflect the second comment.

S-515-1.8—SOIL CORROSION

Commenters suggested that components should have their intended design life specified because of inconvenience and expense of underground repairs or replacement. It is not the purpose of the S/MPS to specify design life. The criteria were changed to reflect an extended expected design life.

S-515-2—COLLECTORS

S-515-2.1—GENERAL

A suggestion was made that the commentary should indicate that consideration must be given in the system design to the need for re-roofing under non-integral roof mounted collectors. This appears valid but the comment is covered under S-601-3.1.

S-515-2.1.1—LABELING

Numerous commenters indicated that the labeling required on collectors was too extensive. Other readers felt the labeling should be more extensive. It was agreed that the data required on collector labels were excessive. The criterion was revised to reduce the data required on labels. However, other data needed are identified for inclusion in technical data sheets.

S-515-2.1.2—THERMAL STABILITY

Extensive commentary was received on this criterion. Some commenters believed the no-flow test is too stringent particularly since collectors with heat dump provisions may not experience stagnation temperatures. Other readers felt the test should be made more stringent. Some felt a 10 percent reduction in the intercept was too severe a requirement, while others suggested a maximum allowable change of 5 percent. Also, a commenter suggested that the error of the thermal performance test is such that a small change cannot be detected. Suggestions were made to both include and omit fluid during the 30-day exposure. Also, some readers felt the 30-day aging procedure should be better specified, i.e. cleaning of glazing, mounting procedures, etc. It was agreed that the procedures should be presented more clearly. However, it was felt that a no-flow test is needed because such conditions are often experienced in actual operations. The test procedure was modified substantially to reflect pertinent comments of the readers. In particular, procedures for preparation of collectors prior to the 30-day exposure were presented. Due to lack of definitive test data under stagnation conditions, there remain questions as to the relevance of many of the comments. Therefore, the revised procedure reflects the best judgment based on the existing technology.

S-515.2.2—COVER PLATES

S-515-2.2.1—GENERAL

One commenter observed that the cover plate section covers too wide a range of materials. Also, a reader suggested adding more complete data in Table S-515-2.2 regarding length of life. Also, suggestions were made for revising numbers in the table. A broad range of materials must be covered by the section because numerous materials could be used. The length of life of materials is heavily dependent upon the system and climate in which they are used. Definitive length of life data are not available. The length of life data in Table S-515-2.2 were deleted. Property values included in Table S-515-2.2 were revised to reflect reader comments. The table was moved to Appendix B (Table B-1).

S-515-2.2.3 (NONE)—LABELING AND PRODUCT DESCRIPTION

Numerous comments were received concerning the special requirements of this section. In particular, need for information on chemical composition, fire resistance, flammability and flame spread to be provided was questioned as a considerable burden and of questionable value unless specific test procedures are referenced. It was agreed that this section singled out properties of cover plates rather extensively and it was deleted. Many of the information headings are covered in the general labeling and data sheet requirements or by compliance with other provisions.

S-515-2.2.7 (515-2.2.3.2)—UV STABILITY

Comments were received to the effect that computations of solar transmittance should be based on air mass 2 and that a weathering test is needed. These appear to be valid comments and changes were incorporated to reflect them. In particular, three aging procedures were added.

S-515-2.2.8 (615-2.1.4)—DIRT RETENTION

One commenter suggested the criteria be omitted because dirt retention is a factor beyond the control of the contractor or manufacturer. Others suggested locating water faucets within 100 feet of collectors to allow for periodic washing. Still others suggested editorial changes. Dirt retention may be a factor resulting in reduction of solar transmittance. However, data are inconclusive at present. Despite the fact that dirt retention may be beyond the control of contrac-

tors or manufacturers, if dirt is a potential problem, the owner of the system should be advised of means to overcome or reduce the problem. Editorial changes were made in the commentary and the section moved to 615–2.1.4.

S–515–2.2.9 (515–2.1.3)—OUTGASSING OF VOLATILES

A comment was made that a decrease in thermal efficiency of 2 percent cannot be measured by the recommended test method. This is true and, therefore, the value of 2 percent was deleted.

S–515–2.2.10 (615–2.1.9)—CONDENSATION

One commenter suggested that moisture condensation on covers is not a problem because it is vaporized by sunlight. Another pointed out that the criterion should be specifically made for moisture (excluding other volatiles). Another reader questioned the application of the criterion to passive systems. Recently conducted field investigations have shown that the condensed moisture does *not* necessarily evaporate when heated by sunlight. The second comment appears valid. The section was modified to include moisture buildup.

S–515–2.2.11 (405–12) FLAME SPREAD

Comment was received that this section was most applicable when evaluated as a roof assembly. This appears to be a valid comment and the section was rewritten to reflect this and relocated as S–405–12.

S–515–2.3—ABSORBER PLATE

S–515–2.3.1 (515–2.3.2.1) THERMAL STABILITY

A comment was received that the test should be performed at the minimum service temperature as well as at no-flow temperatures. The temperature differentials experienced in stagnation testing may be substantial. The criterion was revised to clarify the evaluation procedure.

S–515–2.3.3 (515–2.3.2.3)—COMPATIBILITY WITH TRANSFER MEDIUM

Numerous comments were received on the tables associated with this requirement and on the commentary. Corrosion is a complex phenomenon and the kinetics of the corrosion process are dependent on a large number of variables. As a consequence, in the absence of specific operating conditions, it is not possible to specify materials selection criteria. Rather, it is only possible to provide guidelines which indicate use conditions generally considered to be acceptable or unacceptable for a given class of metals. Significant revisions were made in the tables and the commentary to reflect the readers' comments.

S–515–2.4—ABSORPTIVE COATINGS

S–515–2.4.2 (515–2.4.2.1)—THERMAL STABILITY

A commenter said that documentation is needed to demonstrate the validity of the evaluation tests mentioned in the criteria. The tests mentioned are accepted standards by ASTM for evaluating coatings. Despite the fact that data are desirable for addressing the comment, no such data are yet available. No changes were made in this section.

S–515–2.4.3 (515–2.4.2.2)—UV STABILITY

One commenter said the proposed tests are merely screening tests. Other comments were that the aging test should also permit outdoor exposure and other acceptable methods. Another reader felt the criterion should be omitted because the UV stability could be determined as in the thermal stability test. The first two comments appear valid. It is felt, however, that a 30-day stagnation test is not adequate for determining UV stability of coatings. The requirement was revised substantially. In particular, three methods of aging have been provided.

S–515–2.4.4 (515–2.4.2.3)—MOISTURE STABILITY

One commenter indicated that if the coating cannot pass the recommended test, then long-term tests will be necessary. The recommended test is an ASTM standard and is judged to be a useful evaluation tool, therefore, no changes were made.

S–515–2.5—COLLECTOR ENCLOSURE

One commenter suggested adding a requirement to protect components of collectors or buildings from moisture in open collectors. Another said a section on how to install the enclosure is needed. Another indicated that no cracking at all should be allowed if the collector is used as the roofing membrane. The first comment appears valid. There are many ways to install an enclosure. The S/MPS is not an appropriate document for listing them. The final comment is already covered by the criterion. A new requirement on leakage has been added (S–515–1.10). The format of the collector enclosure section was revised and appears in S–515–2.5.1.

S–515–2.6—REFLECTIVE SURFACES

One commenter suggested considering the effects of airborne abrasives, cleaning, etc. on the surfaces. Another indicated the 10 percent loss of reflectance is rather restrictive. A reader expressed concern regarding size of hail used for tests. The first and third comment appear valid. The 10 percent loss in reflectance is judged to be a reasonable level. The effects of airborne abrasives, etc. are covered in the general requirements (S–515–1.5, S–515–1.7). The criterion for hail resistance was deleted since it was covered in S–601–7.

S–515–3—ENERGY TRANSPORT SYSTEM

S–515–3.1—APPLICABLE STANDARDS FOR LIQUID SYSTEMS

S–515–3.1.2—OTHER STANDARDS

A commenter indicated concern that some materials are excluded by Appendix Table B–4. The S/MPS are not intended to exclude specific materials and the tables are recommendations only. Editorial modifications were made in the Appendix tables.

S–515.3.1.4 (S–515–3.2.2)—CHEMICAL AND PHYSICAL COMPATIBILITY

One reader indicated that some degradation should be allowed. Another suggested cathodic protection as a means of possibly avoiding problems. These are valid suggestions and the wording of the criterion was changed to reflect the first comment. The second comment is addressed by S–515–1.8.

S–515–3.2 (S–515–3.3) APPLICABLE STANDARDS FOR AIR SYSTEMS

A comment that SMACNA be referenced in the criterion was adopted. The reference to humidifiers was questioned and sections 515–3.2.2 and 515–3.2.3 deleted.

S–515–6—PUMPS AND FANS

A comment was made that heat pump criteria should be included in another location in the document. It was felt that heat pumps are standard equipment and that specially noted requirements are not necessary in this document. Thus, such references were deleted and 515–6.2 redesignated 515–6.1.

S–515–7—THERMAL STORAGE UNITS

S–515–7.1—GENERAL

A reader expressed the view that storage units should not be required to last for the lifetime of the building, as indicated in the commentary. The commentary pointed out that, if storage units are inaccessible for replacement, they should perform their function for the lifetime of the building. Although this was not a requirement for the storage unit, it is believed to be a reasonable expectation. The commentary was deleted.

S–515–7.2—APPLICABLE STANDARDS

A commenter questioned why fiber reinforced plastics (FRP) were excluded from consideration as pressure vessels. Appendix Table B–6 contains references to existing standards that may be applicable to materials used in storage units. A standard for FRP at high pressure was not found in the literature. This does not preclude the use of FRP if it can be shown to meet the intent of the criteria in Section S–515–7. Appendix Table B–6 was modified and reference to ASHRAE 94–77 included in the section.

S–515–7.3 (515–7.4.1) CONTAMINATION

The requirements of the U.S. Public Health Service Drinking Water Standards have been made applicable to liquid systems.

S–515–7.4 (515–7.4.2) MATERIALS COMPATIBILITY

One commenter noted that the statement in S–515–7.4a is not pertinent if the thermal storage system is not in contact with the heat transfer medium. Another comment was that Tables S–515–2.3.2 and S–515–2.3.3 may not include materials used for passive systems. Also, a commenter indicated that limits of performance should be stated. These are valid comments, however, it is not pos-

sible to specify limits of materials performance at the present time. Even if materials used for storage units are not specifically mentioned in tables, they may be used after appropriate testing. Revisions were made to reflect the comments.

S–515.8—HEAT TRANSFER FLUIDS

S–515–8.1—GENERAL

The provisions of 515–8.1.2 have been relocated in 515–8.1 and 515–8.1.2 deleted.

S–515–8.1.1—LABELING

Some comments indicated that more information should be included on labels. Others said less should be included. It was felt that a list of compatible materials is not needed and the criterion was modified to reflect the comments. All items except health and safety warnings may be given on a technical data sheet instead of on the container itself.

S–515–8.2.2—FLASH POINT

A number of commenters questioned the requirement for a minimum heat transfer fluid flash point of 400 F. Although system design is the most important safety factor, it is felt that for residential systems, the fluid should be maintained below its flash point. Therefore, the 400 F requirement has been eliminated and the required flash point has been set as a function of maximum system temperature.

S–515–8.2.4—FLUID DISPOSAL—BIODEGRADABILITY AND AQUATIC QUALITY

Comments were received questioning the strictness of these requirements, the validity of using five-day BOD as a measure and the appropriateness of the paragraph's location in Chapter 5. It was felt that these comments raised valid issues and that the basic safety provisions were satisfactorily covered in Subsection S–615–9. For these reasons, the section has been deleted.

S–515–8.3 (515–8.3.1)—CHANGES IN HEAT TRANSFER FLUID

One commenter expressed the opinion that the subsection eliminates the use of many fluids now being used. Several editorial comments were received and one reader referred to published data. The criterion does not eliminate the use of any heat transfer fluid. It states the level of performance expected. All editorial comments were included in the revision. Also, the wording was changed to more clearly state the level of performance expected.

S–515–8.5 (515–8.3.3)—THERMAL STABILITY

One commenter said the criterion should note the effect of fluid on the complete system. Another objected to the use of the term design life. These are valid comments and the criterion was reworded to reflect them.

S–515–9—HEAT EXCHANGERS

A reader indicated that the section should not require double walled heat exchangers. An explanatory commentary was added in 515–9.1. This requirement is similar to that of S–615–10.1.1 and is also discussed under that heading.

S–515–11—INSULATION/THERMAL AND MOISTURE PROTECTION

S–515–11.1.1—FLAME SPREAD CLASSIFICATION

A number of comments were received on this section. Some readers recommended that the flame spread ratings and test methods be made less stringent while others stated that the section was not stringent enough. It is felt that this section in conjunction with Subsection S–607–3, Building Insulation, represents the best insulation standard currently available. Additional introductory remarks have been made in 515–11.1 to clarify the relationship between S–515–11.1.1 and S–607–3.

S–515–11.2—MATERIALS PERFORMANCE

S–515–11.2.1 (515–11.2.1.1)—GENERAL

An objection was made to the references to outgassing problems resulting from freon and to the reference to CO_2 blown insulation. The comments appear valid and appropriate changes were made.

S–515–11.2.2 (515–11.2.1.1)—THERMAL STABILITY

Commenters suggested the evaluation be more clearly tied to the 30-day stagnation test. This suggestion is valid and the section was revised to reflect the comment.

S–515–11.3 (515–11.2.2.)—PIPE OR DUCT INSULATION

Commenters suggested adding a requirement for weathering of insulation. This is a valid comment and is covered by Section S–515–1.2. A commentary referring to the ASHRAE Handbook of Fundamentals was added.

S–515–13—ORGAN COUPLING HOSES

One commenter suggested a more definitive test for thermal stability be included. Another indicated that ASTM D1149–64 (1970) may not be useful for durability testing. Like many existing standard tests, there is some question as to the relevance of these tests to materials for solar systems. However, these tests are believed to be useful in view of the present technology. No substantive changes were made to the section.

CHAPTER 6—CONSTRUCTION

S–600—GENERAL

S–600–1—LABELING

Several commenters suggested ways to clarify and make more consistent the requirements of this section. The suggestions were reflected in revisions made.

S–600–2—ALTERNATIVE CONSTRUCTION

A commenter asked that the method of appeal in the case of variation to standards be described. This was done through the addition of a new section, S–102, Product and Design Modifications.

S–600–3—INSTALLATION, OPERATION, AND MAINTENANCE MANUAL

Comments on this section concerned additional requirements for system clean out and questions regarding its applicability to passive systems. System clean out is covered in S–615–10, Plumbing, and it is felt that the section adequately covers the needs of passive installations. S–600–3 has been expanded to detail the scope of manual to be provided to specified persons.

S–600–4—REPLACEMENT PARTS

A commenter observed that there is no time limit placed on the availability of parts and this would force a manufacturer to maintain an inventory of replacement parts for an indefinite period. The MPS does not specifically indicate that a manufacturer has to maintain an inventory.

S–600–6—SAFETY AND HEALTH REQUIREMENTS

S–600–6.3—PROTECTION FROM HEATED COMPONENTS

Several commenters recommended that this section should be applied only to accessible components. The suggestion is valid and the section was revised. A suggestion was made to provide safety identification on fill caps and drains of pressurized systems. The section was amended to note this comment.

S–600–6.4—SYSTEM COMPONENT CLEARANCES

Comments were received concerning the inclusion of appliances not covered by the referenced standard and the applicability of the requirement to passive systems. The comments appear valid and this section was rewritten to reflect these suggestions.

S–601—GENERAL STRUCTURAL REQUIREMENTS

S–601–4—WIND LOADS

S–601–4.1—FLAT PLATE COLLECTORS MOUNTED ON ROOFS AND WALLS

S–601–4.1.3

A comment was received that this provision did not adequately cover inflatable collectors. The question of internal pressure on an inflatable collector does not appear to be serious. Inflatable collectors would presumably imply a continuous surface capable of resisting pressure, therefore, no wind should be able to infiltrate and create an internal pressure. A further comment noted the need to consider internal pressure when collectors form an integral part of the roof structure. The section was revised to reflect these comments.

S–601–6—SEISMIC LOADS

Comment was made that this subsection did not agree with the MPS. This comment was correct and the section was revised to make it consistent with the MPS.

S–601–7—HAIL LOADS

Several comments were received questioning the basis of this subsection and

its severity. It was suggested that the loading values be reduced by ½ and that an allowable failure rate be specified. Data, which are not presently available, would be needed to specify a failure rate. The level of load resistance required of collectors is similar to that provided by conventional roofing for all but the central states "hail belt." For these reasons, the comments were not adopted but the section was revised for greater clarity and broadened to cover reflector surfaces and lenses as well as cover plates.

S–601–9—THERMAL DISTORTION

Comments on this subsection were concerned with its lack of definition. The section was revised to alleviate these concerns.

S–601–12—STORAGE TANKS

Several comments were received on this subsection suggesting the need for testing guidelines, greater latitude in accommodating new and innovative designs, and the inclusion of thermal stresses. The section was revised in consideration of these comments with reference to Section S–615–10.10 for leak testing, expanded coverage for non-pressurized and rock-bed storage, and coverage of thermal stresses.

S–607—THERMAL AND MOISTURE PROTECTION

Several comments were received which expressed concern over the allowed variation in insulation values, and some conflicts with other sections concerning areas of application. One comment suggested that efficient operation of movable insulation might be an appropriate requirement in this section. It was felt that this was best covered under thermal design, and no change was made in this regard. The sections on insulation values and areas of application were revised and rewritten to clarify their applicability. A section concerning fire resistance was removed from S–515–11 and incorporated in S–607–3.1 and rewritten to eliminate conflicting requirements. A needed section on waterproofing storage tanks and reservoirs was added.

S–615—MECHANICAL

S–615–1—THERMAL DESIGN

S–615–1.1—GENERAL

Three comments were received concerning the oversizing of solar energy systems by designing the complete heating system to meet design winter *24-hour* heating loads in terms of collector and storage size. The requirement has been retained but the commentary has been rewritten to clearly indicate that the solar energy system is designed on the basis of the *average* 24 hour heating load for the peak heating month. Another comment suggested the use of additional building thermal insulation with solar systems. While this is highly desirable, the use of building thermal insulation is covered in Section 607–3 of the MPS and it is not the intent of this document to alter the non-solar building aspects.

S–615–1.2—BACK-UP

The questions related to the role of the back-up system and the capability to provide up to 100 percent of the heating requirements were raised partly because of confusion between the auxiliary role and the back-up role. Both the requirement and commentary were modified to state that the solar energy system contribution shall be completely backed up with reliable auxiliary thermal energy subsystem capable of meeting heating and hot water requirements. Back-up for cooling is not required because the document does not include cooling. Additional comments related to the effect of demand on utilities and aggravation of peak loads is addressed throughout Section S–615–1.3.

S–615–1.3—SYSTEM CAPACITY—SPACE HEATING

S–615–1.3.1—AUXILIARY ENERGY SUBSYSTEM

The comments regarding the use of auxiliary energy to minimize peak energy loads were very appropriate. A statement was added to the commentary to emphasize the benefits gained by coordinating the auxiliary energy usage from on-line, utility supplied sources with non-peak times. Further suggested limitations on the capacity of auxiliary heating or hot water systems are not desirable at this time because of the lack of experimental data on practical ratios of solar contribution to total load for various climatic regions. The influence of tolerable comfort levels, control system capabilities and building energy budgets will significantly effect pertinent absolute standards.

S–615–1.3.2 A AND B—SOLAR ENERGY SYSTEM

Several comments on the accuracy and detail of methods for calculating the building load and solar energy system performance were received. Suggestions ranged from the use of hourly data to "a simple calculation would suffice." The concern with the complexity of calculations is appreciated but the initial prescribed minimum use of average monthly climatic data and loads at the maximum time period, when these were based upon correlations using more detailed analysis procedures, represents a compromise in complexity and cost until more experimental evidence is available. It is not the intent that every single family dwelling be analyzed if data for a similarly constructed dwelling and climatic region are available. However, the sizing significance in terms of initial and life cycle cost for a solar energy system is such that more precise prediction of heating loads is required. Procedures such as the one used in Appendix A use monthly average conditions based upon hourly correlations to predict average performance over several years.

The comment that a system field test procedure be added in this section is not considered practical for the current stage in the development of systems. Many systems are assembled in the field with variations in construction, installation and controls an dthe components originate from a variety of manufacturers.

S–615–1.4—SYSTEM CAPACITY—DOMESTIC HOT WATER HEATING

S–615–1.4.1—AUXILIARY ENERGY SUBSYSTEM

The comments and the response for domestic hot water (DHW) heating systems are generally the same as for space heating described in paragraph S–615–1.3. A commentary statement was added indicating that the minimum acceptable DHW storage was as listed in the MPS but that solar energy systems generally have larger storage through the use of preheater containers.

S–615–1.4.2 A, B, AND C—SOLAR ENERGY SYSTEM

Many comments were directed at the design DHW demand, source water temperature and delivered hot water temperature. Since these parameters are so variable with individual requirements and local conditions, the original criteria were established as typical for design purposes where specific site values were unknown. In order to provide demands more realistic of dwelling or apartment size, a table was added listing the minimum demand to be used. A table of source water temperatures was added to Appendix A to provide an indication of the values found in fourteen U.S. cities. The specification of delivery temperature of 140F aroused the greatest concern because of its impact on solar collector efficiency. Although many residential requirements can be satisfied with about 120F temperature, the 140F is a HUD requirement to meet the needs for certain types of appliances and changes in the MPS will be required before the DHW system design temperature can be altered.

Another comment suggested a required minimum flat plate collector area and storage volume as a function of the number of bedrooms. After performing calculations of the requirements and performance with climatic region, solar energy system and component characteristics and cost factors, it was decided that additional experience is desirable before establishing such minimums for size or performance.

S–615–1.5—SYSTEM CAPACITY—COMBINED SPACE AND DOMESTIC HOT WATER HEATING SYSTEMS

Concern was expressed by one commenter that electrical operating energy was selected for comparison with the thermal performance predictions. In reality, the intent is to determine how much electrical energy was required to operate the system.

S–615–1.6—ENVIRONMENTAL CONDITIONS—PASSIVE SYSTEMS

One comment on this section questioned what "indoor design condition" referred to but as indicated in the subsections, space temperature is the only design condition discussed. Other com-

ments suggested clarification of the use of the words "fluctuations" and "gradients" when used in conjunction with temperature. The criteria and commentary were carefully rewritten to indicate that temperature gradients were the primary method of transferring energy in and that temperature fluctuations and differences resulted from this passive control method. Therefore, although large temperature extremes may be tolerated in non-occupied spaces, provisions are required to maintain the MPS design conditions during occupancy.

As suggested by another commenter an additional criteria, S–615–1.9 "Excess Collected Energy," was added to provide for the dumping of excess collected thermal energy.

S–615–1.8—SYSTEM SHUTDOWN

Several commenters objected to the provisions that the shut down of the heating or DHW systems in one unit shall not interfere with the system function in other units. Because it may not have been clear, the word solar was added to clearly identify that the provision applied to the solar energy system and it is not intended to be different from the MPS for conventional systems.

S–615–2—COLLECTORS

S–615–2.1—GENERAL PROVISIONS

S–615–2.1.1—DESIGN FLOW RATES

Two comments suggested that uniform flow rates can be achieved through the use of properly designed collector manifolds and that a limitation in unbalance be established. A tolerance of ±20 percent in flow rate variation from design was added as well as modifying the criteria to indicate that the design or other provisions shall be used to obtain acceptable flow.

S–615–2.1.2—TILT AND ORIENTATION

Several additional considerations were suggested and added to the commentary regarding considerations of collector orientation. These included morning and evening fog or local architectural restrictions. The use of an adjustable collector is a further design option.

S–615–2.1.3—SHADING

Comments indicating that the shading criteria needed design limits was acknowledged by adding to the commentary a design goal of not reducing the collected useful thermal energy by more than 5 percent by shading during the month of peak load requirements.

S–615–2.2—COLLECTOR THERMAL PERFORMANCE

S–615–2.2.1—GENERAL

It was suggested that a separate criterion be established for thermosyphon systems since they are technically passive systems. This comment was valid, therefore, a section, S–615–2.2.5, Passive: Component (Thermosyphon) Systems, has been included in this document. The added section and commentary describe collector performance tests but detailed system performance test methods are not currently available. The commentary identifies some of the key considerations for designing or evaluating a thermosyphon system.

S–615–2.2.2—COLLECTOR: COMPONENT

Concern was expressed about the lack of thermal performance test methods for collectors when combined with storage and passive type collectors. Admittedly, adequate test methods are not available for integrated type collector units but the document would certainly be remiss if it did not acknowledge or permit their use. It should be realized that the collector test method (ASHRAE Standard 93–77) was accepted during the final preparation stages of this document and as other test methods become available, they will be included. Because of the need to gain experience with the available test method in various climatic regions and collector types, it has been cited in the commentary only and analytical performance predictions are required.

Pertinent comments were made regarding the acuracy of the ASHRAE Standard 93–77 and the commentary that states a ±5% accuracy is desirable. The comments argued that the method is not accurate to ±5%. It has been demonstrated that test data on the same collector can be obtained to within a couple percent when exposed to the "same" conditions. The difficulty in applying the test procedure is that the environmental exposure conditions cannot be adequately characterized or controlled and that variations in performance for currently allowable outdoor exposure conditions result in a spread of loss coefficient data of ±15%. In order to minimize this spread in data for the evaluation of collector degradation, measurements before and after exposure are required in the same climatic region and by the same measurement apparatus.

S–615–7—THERMAL STORAGE

S–615–7.1—GENERAL

A comment suggested that considerations of algae, mold, etc. related to health or increased heat transfer film coefficients be added. Section S–615–7.2, Applicable Standards, citing appropriate MPS design standards, was added to cover these factors. Statements regarding the design lifetime of inaccessible storage systems have been removed from this section.

S–615–7.3—THERMAL STORAGE REQUIREMENTS

A number of comments were received which were critical of the establishment of a minimum storage capacity for residences. However, after careful consideration of the size specified as a minimum, the major benefit of thermal storage from either collectors or other conventional sources at non-peak hours and the importance of incorporating the design of the thermal energy storage into newly constructed buildings, it was decided that the advantages of specifying some storage capability outweighed the possibility of seriously impacting solar energy system design innovations. A description of the basis for calculating the storage capacity was added to section 615–7.3.1. Commentary was added in 615–7.3.3 to indicate that less storage could be used if justified on the basis of system efficiency.

S–615–7.3.4—THERMAL ENERGY LOSS

Conflicting comments were received regarding the magnitude of the losses from thermal storage. Some comments indicated 10% was too high for externally placed tanks, others indicated it was too low, and one comment suggested it be determined strictly by cost. At the suggestion of another commenter, the requirement was made mandatory for externally located tanks only to be based upon an average 24 hour winter design day. The commentary was expanded to state that thermal losses from containers within the building can be helpful in the winter and harmful in the summer and must also be considered in the design. Losses for passive systems should also be considered but they are generally peculiar to each design and require individual determination.

S–615–7.4—TANK DRAINAGE

Two commenters were concerned whether the drainage requirement was adaptable to plastic bags and storage drums. Another commenter suggested that equal provisions be made for underground storage. As stated, the requirement clearly applies to all storage containers. The commentary was expanded to cover the underground rock storage containers.

S–615–7.6—INLET AND OUTLET LOCATION

The suggestion that the inlet and outlet connections to the storage tanks be designed and located to prevent thermal "short-circuiting" was incorporated as a separate requirement.

S–615–8—HEAT TRANSFER FLUIDS

S–615–8.1—TOXIC AND/OR FLAMMABLE MEDIA

S–615–8.1.2—DETECTION OF TOXIC AND/OR FLAMMABLE FLUIDS

Several comments were received concerning the strictness of this requirement. Some felt that this requirement was more demanding than those for conventional heating systems. Solar installations may involve the use of heat transfer fluids that are new and unusual to residential applications. Some may be toxic or combustible and may be in systems operating at high temperatures in configurations that are not familiar to occupants or service personnel. For these reasons, it was felt that recognition was a necessary requirement. The section was modified to require recognition of leaks and thus the warning of occupants. Further clarification was also made of its applicability to toxic and combustible fluids.

S–615–9—WASTE DISPOSAL

Ambiguous terminology and excessive application requirements were the sub-

stance of several comments made on this section. In some instances, an improper interpretation of the requirement led to the comment, in others it was felt that valid points had been raised. The section was revised to require catchment for toxic and/or combustible fluids from pressure relief valves, service drainage, and identifiable leakage.

S–615–10—PLUMBING

S–615–10.1—HANDLING OF NON-POTABLE SUBSTANCES

S–615–10.1.1—SEPARATION OF CIRCULATION LOOPS

In the process of revision, this section became the subject of several comments. The commenters felt that the requirement of a double wall between potable and non-potable circulation loops was overly restrictive and in some instances counter to the prevention of contamination. While it is conceivable under some circumstances to have contamination with double wall systems, this is currently the method with most widespread code acceptance and it was felt that without a broader knowledge base of actual installation configurations, the double wall provision should be retained. The section was revised to allow systems which offer equivalent safety. This provision should allow latitude for innovative designs that provide a safe installation.

S–615–10.3 (615–10.5)—SYSTEM DRAINAGE

Commentary suggested that drainage of all components would be difficult to achieve. It is believed that with proper system design, this should not be difficult and consequently, the requirement was not changed.

S–615–10.5 (615–10.7)—PROVISION OF VALVES AND FITTINGS

S–615–10.5.4 (615–10.8)—SYSTEM CLEANING

Comments which were received on the stringency and application of this requirement raised valid points. The section was rewritten as Section S–615–10.8, System Cleaning, to more accurately reflect the desired procedures.

S–615–11 AUXILIARY ENERGY SYSTEMS

The comment indicated that the interconnections between the auxiliary and solar heating systems be included. An additional requirement (Section S–615–7.7, Auxiliary Energy Location) was added to specify the locations of heating elements or heat inlets into storage. Another requirement, Section S–615–11.2, System Interconnections, was added to cover excessive temperature, pressure, or safety aspects of integration of these two systems. Other portions of the integration are covered by the MPS as referenced.

S–615–12—HEAT EXCHANGERS

S–615–12.1—SIZING

One commenter objected to any statement regarding heat exchanger sizing, while another indicated the specification of a minimum effectiveness value of 0.7 was precluding the development of inexpensive, low effectiveness devices. This extremely important system component has not received sufficient emphasis in many designs and, therefore, the method of calculating the effectiveness has been retained. The specification of a minimum effectiveness was moved to the commentary but indicated to be a typical value. Further illustrations of determining the effectiveness were incorporated in Appendix A. The calculation procedure does not apply to passive systems as mentioned by one comment.

S–615–12.2—HANDLING OF NON-POTABLE FLUIDS

The several comments received under this heading have been discussed under Section S–615–10.1.1, Separation of Circulation Loops. A new section S–615–12.2 has been added and titled, Protection Against Maximum Temperature, Pressure and Vacuum.

S–615–13—AIR DISTRIBUTION

S–615–13.2—DUST AND DIRT PREVENTION

The requirement for air filters on the outlet of rock bed storage could be very detrimental to the function of passive systems as was pointed out by one commenter. The section was revised to correct this requirement.

S–615–14—CONTROLS AND INSTRUMENTATION

A number of comments were received on this section concerning location of protective devices, definition of flammable and combustible fluids, and modification or deletion of the temperature relief requirement. It was felt that pressure relief was adequate and the section was rewritten with temperature relief eliminated and with additional commentary added to clarify the pressure relief requirement including questions of location or protective devices.

Several comments were received concerning the requirement for differential thermostat controls stating that this was an undesirably narrow requirement. The comments appear to be valid and the section has been revised.

APPENDIX A—CALCULATION PROCEDURES FOR DETERMINING THE THERMAL PERFORMANCE OF SOLAR DOMESTIC HOT WATER AND SPACE HEATING SYSTEMS

The interest and general agreement in providing a simplified procedure for evaluating solar energy system performance indicated the need and usefulness of Appendix A. Comments that the scope should be increased to cover a larger number of system types was accommodated by adding specific examples for an air heating system and a domestic hot water system. Correlation studies have been performed to apply the f-chart method to systems that are similar to the types described in the Appendix. Increasing the scope of the examples, as suggested by several commenters, to include heat pump assisted systems and passive systems, will be done as the correlation data and f-chart curves are prepared.

It must be emphasized that the applications of the procedure described in Appendix A are to evaluate systems performance and are not intended to size or optimize the system performance as some of the comments inferred. The comments regarding the complexity of determining factors such as available insolation, building loads and collector parameters have been addressed by expanding explanations or data for each of the pertinent sections. For instance, US maps showing the average daily insolation for each month were added for use in geographic areas where specific data are not available or where calculations from extraterrestrial values are not warranted. Appreciation of local differences in insolation and seasonal or annual variations of 20% must be considered in applying the data for short term predictions. Methods of applying collector thermal performance data, expressed in terms of the amount of absorbed solar energy ($F_R\tau\alpha$) and thermal energy loss (F_RU_L) for the system operating conditions, are described for any collector. Some additional collector data may be required if significant angular or spectral sensitivities are an inherent characteristic associated with all-day performance.

A few commenters suggested alternative procedures (referenced in the document) as being simpler or more comprehensive. A relatively large variety of system performance prediction methods are available with specific features. However, the f-chart method was selected for illustration purposes because it represents the greatest potential use in terms of collector characteristics, validity by correlation with detailed analysis and computational versatility (either computer or hand calculation). It is expected that experimental results over the next five years will result in modification and improvement of all prediction methods to provide accurate design and evaluation methods.

APPENDIX B—MATERIALS TABLES

TABLE B—THERMAL STORAGE UNIT CONTAINERS

A comment was received that suggested that wood containers may be useful for both liquid and air. A commenter questioned whether or not liners could be used and if FRP vessels could be used under high pressure. The table is included as a guide to help in identifying standards for materials that may be used in storage units. However, the table does not exclude liners or FRP vessels under high pressure. These would be covered under Criterion S–101–1. Several changes were made in the table; one for clarification and one to include wood.

TABLE B–5—TYPICAL HEAT TRANSFER FLUIDS

A comment was made that flash point may be dependent upon viscosity; therefore, the data should reflect the test conditions. This is a valid observation; however, manufacturer's data do not always describe test conditions used to obtain data. A footnote was added to note this comment. A comment was received concerning the definition of toxic and nontoxic heat transfer fluids, particularly

water with inhibitors. The concern appears valid and the table was revised to reflect this. Also, editorial changes were made.

TABLE B–6—TYPICAL CORROSION INHIBITORS

Numerous comments were made with suggestions for additions or deletions. However, upon examination of these comments, it was decided that it is not possible to present inhibitor data in a generalized table and the table was deleted.

TABLE B–7—COMPARATIVE CHARACTERISTICS AND PROPERTIES OF SEALING COMPONENTS

It was suggested that the heading, "Silicone," be revised to include both one and two part materials. Also, numerous suggestions were made for revising the data in the table. The table was revised to reflect these comments.

TABLE B–8—UPPER TEMPERATURE LIMITS FOR INSULATION MATERIALS

A commenter suggested the table be deleted. Because of the difficulty of finding authenticating test data for the values listed, it was decided to delete the table.

APPENDIX C—ILLUSTRATED DEFINITIONS

Several comments were received suggesting changes to and the rewording of certain terms on the illustrated drawings. It was decided to redo a number of the drawings for greater clarity and change certain terms. The "solar window" drawing was corrected.

APPENDIX D—DEFINITIONS

Two comments were received about Appendix D. The first commenter suggested that the definition of "design life" be more specific. The second suggested that the relationship of the three types of collectors (combined, component, and integrated) to active and passive solar systems be stated. Though the definition of "design life" was not modified, its usage in the criteria was greatly reduced and a definition was added to describe what was meant by "significant (determination, loss, etc.)" in performance. The comment on collector types was reflected in changes made in these definitions.

An official, historic file of the Minimum Property Standards, the revisions and supplements including S/MPS is available in the Office of Technical Support, Room 6160, Department of Housing and Urban Development, Washington, D.C. and in each HUD Regional, Area, and Insuring Office. A copy of the standards, revisions, and supplements is also maintained in the Office of the Federal Register, Washington, D.C. Copies of the MPS, the revisions, and supplements can be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

A Finding of Inapplicability respecting the National Environmental Policy Act of 1969 was made in connection with the proposed rule and is applicable to this final rule. A copy of this Finding of Inapplicability will be available for public inspection during regular business hours in the Office of the Rules Docket Clerk, Office of the Secretary, Room 5218, Department of Housing and Urban Development, 451 7th Street, SW., Washington, D.C. 20410.

NOTE.—It is hereby certified that the economic and inflationary impacts of this final rule have been carefully evaluated in accordance with Executive Order No. 11821. (Sec. 7(d), Department of Housing and Urban Development Act (42 U.S.C. 3535(d)).)

Issued at Washington, D.C., June 23, 1977.

LAWRENCE B. SIMONS,
Assistant Secretary for Housing—Federal Housing Commissioner.

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